ENVIRONMENTAL RESOURCES MANAGEMENT GROUP

FINAL REPORT

Aubrey Manufacturing, Inc.

Ground Water Monitoring Report *Third Quarter 1999*

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Project No. 2060

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EXECUTIVE SUMMARY

Ground water monitoring for the third quarter of 1999 was performed at the Aubrey Manufacturing, Inc. (Aubrey) facility in Union, Illinois on September 16, 1999. The monitoring activities are required under the Closure Plan for the former surface impoundment at the site. The objective of the ground water monitoring is to assess the current and historic ground water quality in the immediate vicinity and downgradient of the former surface impoundment.

The ground water monitoring activities included measuring static water levels, collecting field data to assess biodegradation activity, and analyzing ground water samples from select monitoring wells for volatile organic compounds (VOCs) and dissolved chromium, nickel, and lead. The monitoring activities were performed in accordance with the procedures specified in the Closure Plan, as modified.

The types, concentrations, and distribution of contaminants detected in the third quarter 1999 ground water samples generally are consistent with the results from previous sampling events. The extent of the ground water plume and the VOC concentrations within the upper and lower levels of the plume remained essentially the same as during the third quarter 1998 and first quarter 1999.

The water levels are similar to the third quarter 1998 measurements, and the ground water flow direction and gradient are consistent with previous monitoring events. Lastly, the biodegradation data support the conclusion that the ground water plume is naturally attenuating via reductive dechlorination.

1.0 *INTRODUCTION*

This report summarizes the ground water monitoring activities conducted at the Aubrey facility in Union, Illinois, during the third quarter of 1999 as part of closure activities associated with a former surface impoundment at the site. The objective of the ground water monitoring is to assess the current ground water quality in the immediate vicinity and downgradient of the former surface impoundment. The methods used to complete the ground water monitoring activities are specified in:

- Attachment 2 of the Closure Plan - Surface Impoundment, Aubrey Manufacturing, Inc., Union, Illinois, dated April 15, 1993 (the "Closure Plan");
- A letter, dated December 1, 1994, addressed to Mr. Lawrence W. Eastep, P.E., Manager Permit Section, Division of Land Pollution Control, Illinois Environmental Protection Agency (IEPA);
- A letter, dated March 8, 1996, addressed to Mr. Edwin C. Bakowski, P.E., Manager Permit Section, Division of Land Pollution Control, IEPA;
- A letter, dated April 16, 1996, addressed to Mr. Michael Wirtz, Aubrey Manufacturing, Inc.;
- Corrective Action Status Report and Work Plan Addendum No. 2 (the "CASRWP2"); and
- Corrective Action Status Report and Work Plan Addendum No. 3 (the "CASRWP3").

Aubrey retained ERM C&O Services, Inc. (ERM) to perform the ground water monitoring activities at the facility.

2.0 *INVESTIGATIVE METHODS*

The ground water monitoring activities performed during the third quarter of 1999 included:

- The measurement of static water levels in all of the monitoring wells to assess the direction of ground water flow,

- The collection and field analysis of ground water samples from all of the monitoring wells to assess biodegradation activity, and

- The collection and laboratory analysis of ground water samples from select monitoring wells to assess the ground water quality.

2.1 *WATER LEVEL MEASUREMENTS*

The static water levels in all of the monitoring wells at the site were measured on September 16, 1999. The measurements were obtained in accordance with the procedures specified in the Closure Plan.

2.2 *GROUND WATER BIODEGRADATION PARAMETER MEASUREMENTS*

Measurements of dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, pH, and specific conductance were obtained from all of the ground water monitoring wells on September 16, 1999. The measurements were obtained in accordance with the procedures specified in the CASRWP2. ERM obtained *in situ* DO and ORP measurements of the ground water before sampling began. ERM believes the first *in situ* measurement from each well is the most representative of the actual ground water conditions because the measurement is taken before the well water is extensively disturbed by the sampling activities.

2.3 *GROUND WATER SAMPLING*

ERM collected ground water samples from select monitoring wells at the site on September 16, 1999. Figure 1 shows the locations of all the monitoring wells at the site. The ground water monitoring plan (including the wells to be sampled, sampling frequency, and analytical methods used) is summarized on Table 1. The samples were obtained in accordance with the procedures outlined in the Closure Plan, subsequent correspondence with the IEPA, the CASRWP2 and the CASRWP3. The samples were analyzed by Great Lakes Analytical (GLA) of Buffalo Grove, Illinois for selected VOCs, and dissolved chromium, lead, and nickel. The samples were analyzed using methods described in the U.S. Environmental Protection Agency's (USEPA's) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, as specified on Table 1.

Five samples were collected and submitted for quality control (QC) purposes, including one matrix spike (sample MW-7MS), one matrix spike duplicate (sample MW-7MSD), two field duplicates (samples MW-13DD and MW-8SD), and one field blank (sample MW-10B).

3.0 INVESTIGATION RESULTS

3.1 GROUND WATER ELEVATIONS

The static water level measurements obtained from the monitoring wells at the site are summarized on Table 2. The September 16, 1999 static water levels are lower than the March 16, 1999 static water levels, but similar to the previous third quarter static water levels. In general, the quarterly water levels at the site have remained relatively constant over time. The direction and gradient of ground water flow in the upper and lower water-bearing intervals were evaluated by constructing ground water contour maps from the static water elevation data. Figure 2 is the ground water contour map for the upper water-bearing interval on September 16, 1999. Figure 3 is the ground water contour map for the lower water-bearing interval on September 16, 1999.

The ground water contour maps for the third quarter of 1999 are consistent with previous ground water contour maps. Ground water in the upper water-bearing interval flows toward the southeast at an average horizontal gradient of approximately 0.019 foot/foot (Figure 2). A slightly steeper horizontal flow gradient is present beneath the western portion of the manufacturing building and may reflect the change in topography along the building addition. As evidenced by water seeping from both banks of Railroad Creek, the ground water in the upper water-bearing interval discharges to the stream (Figure 2).

The potential for ground water flow in the lower water-bearing interval is northeasterly at an average horizontal gradient of approximately 0.015 foot/foot (Figure 3). The ground water flow direction and gradient are similar to previous third quarter measurements. The ground water in the lower water-bearing interval is under confined conditions.

A comparison of the static water level measurements taken in the upper and lower water-bearing intervals shows the presence of a consistent downward vertical flow gradient on the Aubrey property and a seasonal downward vertical flow gradient near Railroad Creek. The magnitude of the downward vertical gradient ranged from 0.0033 foot/foot (between monitoring wells MW-18S and MW-18D) to 0.081 foot/foot (between monitoring wells MW-9S and MW-9D). An upward vertical gradient previously was recorded between monitoring wells MW-18S and MW-18D during the third quarter 1997 and third quarter 1998 ground water sampling periods and shows that the potential for ground water in the lower water-bearing interval to migrate upward and discharge into Railroad Creek occurs on a seasonal basis.

The basal water-bearing interval is intersected by two monitoring wells, MW-8D and MW-17D. Static water level data from these wells indicate that the ground water is under confined conditions and the apparent ground water flow direction is toward the east, with an average horizontal gradient of 0.0022 foot/foot. A comparison of the static water level measurements taken in the upper and basal water-bearing intervals (MW-8S/MW-8D and MW-17S/MW-17D) shows a consistent downward vertical flow gradient on the Aubrey property and near Railroad Creek. These data indicate that ground water in the basal interval does not discharge to Railroad Creek on a seasonal basis as it does in the upper and lower water-bearing intervals.

3.2 *GROUND WATER SAMPLING RESULTS*

The ground water analytical data are summarized on Table 3 for the wells intersecting the upper water-bearing interval, Table 4 for the wells intersecting the lower water-bearing interval, and Table 5 for wells intersecting the basal water-bearing interval. The ground water analytical data are compared to the Class I and Class II ground water standards presented in 35 IAC 620.410 and 35 IAC 620.420 and the surface water quality criteria (SWQC) established by the IEPA for Railroad Creek. The standards that apply to each of the water-bearing intervals and the rationale for comparing the data to these standards is described in Section 2.3.1 of Corrective Action Status Report and Work Plan Addendum No. 3.

The analytical data obtained during the third quarter of 1999 are discussed in the following subsections. The laboratory report is included as Appendix A.

3.2.1 *Volatile Organic Compounds*

The VOC data for the third quarter 1999 ground water samples are valid, usable results that satisfy the data quality objectives (DQOs) for this project. The field blank (MW-10B) contained no detectable VOCs, indicating that the decontamination procedures were effective in preventing cross-contamination. The results from the field duplicate wells (MW-13DD and MW-8SD) show good correlation with their associated investigative samples (MW-13D and MW-8S), indicating good data reproducibility. The results of the MS, MSD, and surrogate spike analyses are all within the required quality control limits.

As shown on Table 3, investigative samples obtained from five of the upper water-bearing interval wells (i.e., MW-8S, MW-9S, MW-11, MW-13S, and MW-18S) contained detectable concentrations of VOCs. Three of those wells (i.e., MW-8S, MW-9S, and MW-13S) contained VOCs at concentrations exceeding the Class I standards, and no samples exceeded the SWQCs (Table 3). The VOCs detected in the upper interval include trichloroethylene (TCE); 1,1,1-trichloroethane (TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); and vinyl chloride (VC) (Table 3). 1,1-DCE and VC were the only VOCs detected at concentrations exceeding the Class I standards.

Samples obtained from two of the lower water-bearing interval wells (i.e., MW-13D and MW-14) contained detectable concentrations of VOCs (Table 4). Both samples contained VOC concentrations exceeding the Class II standards. The VOCs detected in the lower water-bearing interval include TCE; TCA; cis-1,2-DCE; and VC. However, only TCE; cis-1,2-DCE; and VC exceeded the Class II standards (Table 4).

The two ground water samples obtained from the basal water-bearing interval wells (i.e., MW-8D and MW-17D) contained no detectable VOCs of concern (Table 5). The data demonstrate that the ground water plume does not extend below the lower water-bearing interval.

The types, concentrations, and distribution of VOCs detected in the third quarter 1999 ground water samples are consistent with the results from the previous quarterly sampling events. The vertical and horizontal extent of the ground water VOC plume is essentially the same as during the first quarter 1999.

The concentrations of the individual VOCs that exceed the Class I standards are approximately the same as those detected in the first quarter 1999. The concentration of 1,1-DCE in MW-13S (10 μg/l) continues to decrease from its third quarter 1998 high, but remains above its Class I standard (7 μg/l). The VC, TCE, and/or cis-1,2-DCE concentrations in MW-8S, MW-13D, and MW-14 are stable compared to the concentrations detected in the first quarter 1999, but show an overall decreasing trend. Although MW-9S has not recovered to its pre-test concentrations, the VC concentration continued to decrease and the TCE concentration decreased to a level below its Class I standard.

Overall, the concentrations of the parent chlorinated solvents (TCE and TCA) have continued to decrease in the ground water since the quarterly monitoring began in the fourth quarter 1993. The concentrations of their degradation products (1,1-DCA; 1,2-DCE; and VC) have dropped slightly throughout the monitoring period. Although the VOC concentrations vary on a seasonal basis, the long-term data show a consistent decrease in VOC concentrations. These trends indicate that the plume has stabilized (i.e., it is no longer growing) and is attenuating via reductive dechlorination of the solvents.

3.2.2 *Dissolved Metals*

The dissolved metals data for the third quarter 1999 are valid usable results that satisfy the project DQOs. The field blank (MW-10B) contained no detectable dissolved metals, indicating that the decontamination procedures were effective in preventing cross-contamination. The results from the field duplicate samples (MW-13DD and MW-8SD) show good correlation with the associated investigative samples (MW-13D and MW-8SD) for chromium and nickel. The lead results for MW-8S and MW-8SD do not show good correlation; therefore, the lead results are flagged with a "J" (estimated) qualifier. The laboratory noted that the MW-8S sample was turbid and the MW-8SD sample was not turbid. Both samples were reportedly filtered; however, the higher particulate level in MW-8S is the likely source of the elevated lead concentration in that sample relative to MW-8SD.

As shown on Table 3, samples obtained from four of the upper water-bearing interval wells (i.e., MW-6, MW-7, MW-8S, and MW-11) contained detectable concentrations of dissolved nickel. Three of the samples (i.e., MW-7, MW-8S, and MW-11) contained dissolved nickel concentrations exceeding the Class I standards. MW-11 contained a concentration of dissolved nickel exceeding the surface water quality criteria (SWQC). Dissolved lead was detected in MW-8S at an estimated concentration slightly higher than the Class I standard.

None of the samples from the lower and basal water-bearing interval wells contained detectable levels of dissolved metals (Table 4).

The types, concentrations, and distribution of dissolved metals detected in the third quarter 1999 ground water samples are generally consistent with the results from previous quarterly sampling events. Dissolved nickel concentrations exceeding the Class I standards have been detected consistently in a small area of the upper water-bearing interval immediately downgradient of the former surface impoundment (i.e., MW-6, MW-7, and MW-8S). The nickel concentrations in those wells have decreased 18% to 37% since the third quarter 1998.

Nickel concentrations above Class I standards have periodically occurred in monitoring wells away from the former surface impoundment. Nickel concentrations in samples obtained from MW-11 have increased progressively since the first quarter 1998 sampling event to a concentration of 2,700 μg/l this quarter. The nickel data for other monitoring wells located away from the former surface impoundment are inconsistent in time and space. Slightly elevated dissolved lead concentrations also occur periodically in isolated locations at the site. This quarter MW-8S showed an elevated lead concentration. In accordance with the CASRWP3, the metals data will be evaluated with respect to background concentrations and outliers after the 2000 ground water monitoring results are available.

3.3 *BIODEGRADATION PARAMETERS*

The third quarter 1999 ground water biodegradation parameters are summarized in Table 6. DO in ground water is used as an indicator of aerobic/anaerobic conditions and biodegradation of organic carbon. Low DO concentrations are indicative of anaerobic conditions or increased aerobic biodegradation. The ORP of ground water is used as an indicator of aerobic or anaerobic conditions within an aquifer, and low ORP is indicative of biodegradation of organic carbon.

DO readings ranged from 0.84 to 6.56 mg/l in the upper water-bearing interval, from 3.10 to 7.71 mg/l in the lower water-bearing interval, and from 1.05 to 4.01 mg/l in the basal water-bearing interval (Table 6). With the exceptions of MW-10 and MW-14, DO readings decreased relative to the results from the first quarter 1999 in the monitoring wells on the Site. The temporal changes in DO readings are attributed to seasonal changes in ground water chemistry and to sampling technique.

DO readings are very sensitive to sampling instrumentation and technique because exposing the sample to the atmosphere or agitating the sample may increase the DO concentration. Because the sampling technique involves some agitation of the sample and exposure to the atmosphere, we expect the readings to be biased high.

The DO data collected to date indicate that both aerobic and anaerobic conditions occur at the site during different times of the year depending on seasonal ground water trends. The low DO readings detected near MW-6, MW-7, and MW-13S suggest that enhanced reductive dechlorination may be occurring in the upper water-bearing interval in the immediate vicinity of those wells. The low DO readings detected near MW-13D suggest that enhanced reductive dechlorination may be occurring in the lower water-bearing interval in the immediate vicinity of that well.

ORP readings at the site ranged from -13 mV to 131 mV in the upper water-bearing interval; from 29 mV into 116 mV in the lower water-bearing interval; and from 77 mV to 83 mV in the basal water-bearing interval (Table 6). Since the first quarter 1999 sampling period, ORP readings from the upper water-bearing interval decreased in the monitoring wells MW-6, MW-13S, MW-17S, and MW-18S, and increased in the remaining wells. ORP readings from the lower and basal water-bearing intervals decreased in MW-10, MW-13D, MW-17D, and MW-18D and increased in the other wells. ORP readings are subject to the same sampling susceptibilities as DO readings.

The third quarter 1999 DO and ORP data support the conclusion that reductive dechlorination of the parent (TCE and TCA) and intermediate (1,2-DCE; 1,1-DCE and 1,1-DCA) chlorinated solvents is occurring beneath and immediately to the east of the Aubrey manufacturing building. Aerobic decay of vinyl chloride may be occurring on the east side and downgradient of the site.